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December 8, 1997

RECEIVED

DEC 8 - 1997

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Magalie Roman Salas
Secretary
Federal Communications Commission
1919 M Street, Northwest Room 222
Washington, D.C. 20554

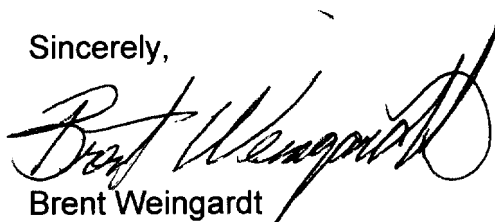
Re: Motorola's Comments in Response to NTIA's Petition for
Rulemaking Regarding a Potential Rule to Establish Out-of-band
Emission Limits for Mobile Earth Terminals (RM-9165)

Dear Ms. Salas:

Enclosed are an original and nine (9) copies of Motorola's comments in response to a Petition for Rulemaking numbered RM-9165 submitted by the National Telecommunications and Information Administration (NTIA) and set out for public comment in FCC Public Notice 2227. These comments are due today.

I ask that you forward these documents to the Commissioners and the Satellite and Radiocommunications Division of the International Bureau as quickly as possible. Please do not hesitate to contact the undersigned if you have any questions.

Sincerely,



Brent Weingardt
Counsel for Motorola Satellite Communications, Inc
and U.S. Leo Services, Inc.

enclosure

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of:

Amendment of the Commission's
Rules To Incorporate Mobile
Earth Station Out-of-Band
Emission Limits

RM-9165

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DEC 8 - 1997

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

TO: The Commission

COMMENTS ON PETITION FOR RULEMAKING

Motorola Satellite Communications, Inc. and U.S. Leo Services, Inc., wholly-owned subsidiaries of Motorola, Inc. ("Motorola"), hereby comment on the Petition for Rulemaking recently submitted by the National Telecommunications and Information Administration ("NTIA") to establish certain out-of-band emissions criteria for Mobile Earth Terminals ("METs").^{1/} Motorola is an interested party in this proceeding as the licensee of the IRIDIUM® System,^{2/} and as the recipient of a blanket

^{1/} See, FCC Office of Public Affairs Public Notice No. 2227, September 23, 1997 seeking comment on proposed MET standards in a letter from Richard D. Parlow of NTIA to Regina Keeney, Chief, FCC International Bureau (September 18, 1997). The Chief, International Bureau later extended the initial comment deadline until December 8, 1997.

^{2/} Application of Motorola Satellite Communications, Inc. for Authority to Construct, Launch and Operate a Low Earth Orbit Satellite System in the 1616-1626.5 MHz Band, Order and Authorization, 10 FCC Rcd 2268 (Int'l Bureau 1995); Erratum, 10 FCC 3925 (1995); Modification granted, 11 FCC Rcd 13952 (1996); reconsideration denied, 11 FCC Rcd 18502 (1996).

license to construct and operate up to 200,000 METs for use with the IRIDIUM® System.^{3/}

In general, Motorola agrees with NTIA on the need to protect adequately from out-of-band interference the Radionavigation Satellite Service operating in portions of the 1559-1610 MHz band. Specifically, Motorola fully supports efforts to ensure that the components of the proposed Global Navigation Satellite System ("GNSS"), the Russian Global Orbiting Navigation Satellite System ("GLONASS") and the U.S. Global Positioning System ("GPS"), can coexist with nearby MSS operations. In this regard, Motorola is the first -- and to this date the only -- MSS licensee to commit to meeting the long term out-of-band emissions standards proposed by NTIA and the Federal Aviation Administration ("FAA").

Since Motorola has already committed to meeting the ultimate GNSS protection criteria, it takes no position on the "time-phased approach" proposed by NTIA. Motorola must point out, however, that NTIA's proposed time-phased approach appears to be inconsistent with the recently approved international standards for METs of NGSO MSS systems.^{4/} For TDMA systems (like the IRIDIUM System) in the 1-3 GHz band, a protection criteria of -70 dBW/MHz at 1605 MHz linearly interpolated to -10

^{3/} Application of U.S. Leo Services, Inc. for blanket authority to construct and operate up to 200,000 portable handheld earth stations for use with the IRIDIUM® System in the 1616-1626.5 MHz band, Order and Authorization, 11 FCC Rcd 20474 (1996) ("Blanket Licensing Order").

^{4/} See "Essential Technical Requirements of Mobile Earth Stations for Global Non-Geostationary Mobile-Satellite Service Systems in the Bands 1-3 GHz," ITU Recommendation. Document 8/114-E (13 June 1997), approved November 29, 1997. (See Attachment 1 hereto).

dBW/MHz at 1610 MHz was established by the ITU. Even for CDMA systems, while further studies are called for, the only protection criteria listed to protect GLONASS is -70 dBW/MHz at 1605 MHz linearly interpolated to -10 dBW/MHz at 1610 MHz. No mention is made of a time-phased approach and in fact the ETSI standard does not even call for further studies on the -70 figure..^{5/} Such inconsistencies may adversely impact other Commission and international initiatives, such as the GMPCS MOU implementation process for facilitating global roaming and licensing of METs..^{6/} In order to minimize any confusion on this point, Motorola urges the Commission to establish separate TDMA and CDMA standards for the type acceptance of METs.

Motorola does seek clarification that if this time-phased approach is adopted, it will not impact licensees, such as Motorola, who have already committed to meeting NTIA's proposed final out-of-band emissions levels. Motorola also urges the Commission to reconcile the differences in its current out-of-band rule for protection of GPS with the NTIA proposal if it decides to move forward with a rulemaking. Finally, Motorola urges the Commission to clarify certain aspects of NTIA's proposal before it is adopted as a technical standard for MET operations.

^{5/} The ITU approved standards are also consistent with recently approved draft standards developed by ETSI. See Satellite Personal Communication Networks (S-PCN): MES, Including Handheld Earth Stations for S-PCN in the 1.6/2.4 GHz Bands Under the MSS; Terminal Essential Requirements. Draft TBR 41 Rev.1.

^{6/} See e.g., News Release, "International Action Arrangements for Global Mobile Personal Communications by Satellite Adopted in Geneva," IN 97-32 (October 15, 1997).

I. THE COMMISSION MUST CLARIFY THAT NTIA'S "TIME-PHASED" PROPOSAL DOES NOT APPLY TO LICENSEES WHO HAVE ALREADY COMMITTED TO MEETING THE PROPOSED MOBILE EARTH TERMINAL FINAL OUT-OF-BAND EMISSIONS STANDARDS

As Motorola understands this proposal, NTIA does not intend to add any requirements to the operation of licensees, such as Motorola, who have already committed to protecting the GNSS at 1605 MHz at or below -70 dBW/MHz for wideband emissions and -80 dBW for narrowband emissions (spurs). This view, however, is not explicitly stated in the NTIA petition. Motorola therefore requests that the Commission clarify in any rulemaking notice that licensees meeting these final values will not be subject to the proposed operational and manufacturing requirements associated with NTIA's time-phased approach.

Last year, Motorola was authorized to construct and operate up to 200,000 METs for use with the IRIDIUM® System.^{7/} In an amendment to its then-pending application, Motorola indicated that it was designing its METs to meet a wideband EIRP emission limit of -70 dBW/MHz and a narrowband EIRP emission limit of -80 dBW in the frequency range 1559-1605 MHz. In so doing, Motorola did not concede that these levels were necessary for protecting GNSS receivers, but indicated that the uncertainty over the appropriate protection level made it prudent to design its METs "to meet the most restrictive limits currently being proposed by the aviation community."^{8/} In the subsequent Blanket Licensing Order, the Commission made no

^{7/} Blanket Licensing Order, 11 FCC Rcd 20474 (1996).

^{8/} Letter from Philip Malet to William F. Caton in File No. 423-DSE-P/L-96, November 20, 1996. Motorola reserved the right to redesign its METs if the Commission subsequently adopted higher out-of-band standards.

finding that Motorola's EIRP levels were necessary to protect GLONASS, but conditioned the award of a license on Motorola meeting any out-of-band emissions standards for GNSS protection subsequently adopted by the Commission.^{9/}

The NTIA proposal is intended to result in the adoption of an out-of-band emissions rule for all METs operating in the L-band. Motorola will meet the NTIA proposed standards for protecting GPS operations in the 1559-1580.42 MHz and 1559-1585.42 MHz bands. Moreover, Motorola's current commitment for GLONASS protection is exactly the same standard that NTIA proposes for adoption by January 1, 2005 -- a wideband limit of -70 dBW/MHz and a narrowband limit of -80 dBW/700 MHz in the band 1559-1605 MHz.

Motorola, therefore intends to meet today the stricter EIRP level that NTIA suggests should be phased-in by 2005. Accordingly, there is no need to subject Motorola to any of the proposed operational and manufacturing requirements associated with the time-phased approach.

In addition, Motorola strongly urges the Commission to consider eliminating the narrowband criteria for protecting GLONASS. There is no similar requirement in either the ITU or ETSI standards. In fact, both standards allow the noise to be measured in a narrower bandwidth than 1 MHz and then scaled to 1 MHz. This measurement technique, in effect, allows the spurs to be at the same level as the noise (i.e., -70 dBW). If the Commission decides against a narrowband spur

^{9/} Blanket Licensing Order at ¶¶ 13, 21.

requirement, MET manufacturers can avoid considerable cost and complexity in these units.

II. THE COMMISSION MUST RESOLVE THE DISCREPANCIES BETWEEN THE NTIA PROPOSAL AND RULE 25.213(b) AND CLARIFY CERTAIN ASPECTS OF THE PROPOSAL

The NTIA proposal is at odds in at least two respects with the Commission's existing GPS protection criteria applicable to MET operations -- Section 25.213(b) of the Rules.^{10/} The Commission must clarify these discrepancies in any rulemaking proceeding resulting from the NTIA petition. The Commission should also clarify how it intends for MET licensees to measure their out-of-band emissions.

First, Section 25.213(b) sets out GPS frequencies between 1574.397 and 1576.443 MHz as qualified for protection from out-of-band MET emissions. The NTIA proposal identifies the 1559-1580.42 MHz band for protection from wideband signals and the 1559-1585.42 MHz band for protection from narrowband signals. The band afforded protection after 2005 is 1559-1605 MHz, for both GPS and GLONASS operations.^{11/} The Commission must reconcile this difference in the GPS frequencies subject to protection from METs on both an interim and final basis. It must also ensure that any resulting rule sets forth only the GLONASS frequencies subject to interim and final protection.

^{10/} 47 C.F.R. § 25.213(b).

^{11/} The current rules do not establish any protection standard for GLONASS operations. See Big LEO MSS Report and Order, 9 FCC Rcd 5936, 5989 (1994).

Second, the Commission must reconcile its definition of what constitutes a narrowband spur.^{12/} Section 25.213(b) currently defines a narrowband spur as a discrete spurious emission of bandwidth less than 600 Hz.^{13/} The NTIA proposal sets the narrowband spur emission level at -80 dBW/700 Hz. The Commission should clarify which definition of a narrowband spur (600 Hz or 700 Hz) is more appropriate.

In either case, Motorola notes that it is currently impossible to measure compliance with either a 600 MHz or 700 MHz spur standard. Spectrum analyzers intended for this purpose have resolution bandwidths of either 300 Hz or 1000 Hz (1 kHz). Motorola recommends that the Commission permit MET licensees to measure these spurs consistent with currently available measurement techniques of either 300 Hz or 1 kHz. Motorola believes this is consistent with current Section 25.213(b), since this rule defines spurs as less than 600 MHz. The Commission should clarify this point. In the alternative, the Commission should set the spur limit at either a per 300 Hz or per 1 kHz level.

Third, Motorola seeks clarification as to the measurement interval to be used by a MET licensee. NTIA states that out-of-band emission power levels "are the average values measured over a 20 msec (ms) time interval."^{14/} In the case of a TDMA signal, the measurement of the noise requirement of -70 dBW/MHz in any 20 ms

^{12/} Again, Motorola urges the Commission to consider whether a narrowband spur requirement is needed at all.

^{13/} See, also, Big LEO Report and Order at 5988.

^{14/} See Letter from Richard D. Parlow at Summary. Motorola notes that the Commission rule for GPS protection states that the measurement will be "averaged over any 20 ms period." 47 C.F.R. § 25.213(b) (emphasis added).

should include the entire transmit burst transmission even if the burst is less than 20 ms. Motorola assumes that 20 ms was selected because the GPS embedded data rate is 50 bps with a period of 20 ms. If a peak detecting spectrum analyzer is used to make these measurements, the peaks will exaggerate the noise by the peak-to-rms (or average) factor of the measurement technique. Moreover, the peak detector will not account for the duty cycle of the TDMA transmitter and again will exaggerate the noise measurement. Therefore, the Commission should clarify that an MSS licensee should be permitted to develop a measurement technique that is a more accurate measure of the average noise in the 20 ms interval, and not have to report incidental spectral peaks.

Fourth, at the band edge, the noise spectral shape may start to rise and a 1 MHz measurement centered near or at the edge will exaggerate the noise while the true noise below the band edge may be lower. Accordingly, lower resolution bandwidths should be allowed to filter out the spectral shape above the band edge, which is also consistent with the ITU and ETSI recommendations.

Motorola believes that the Commission can account for these factors in several ways: (1) by allowing non-peak detectors to be used; (2) by allowing the noise to be measured over a 1 MHz bandwidth using an integration of the measured noise values by the spectrum analyzer (a standard spectrum analyzer feature); and (3) by allowing bandwidths smaller than a resolution of 1 MHz, integration over 1 MHz, and correction of the resultant integrated noise value by the duty cycle of the transmitter.

III. CONCLUSION

Motorola respectfully submits that the Commission take these comments into account if it decides to institute a rulemaking proceeding.

Respectfully submitted,

**MOTOROLA SATELLITE
COMMUNICATIONS, INC.**

U.S. LEO SERVICES, INC.

A handwritten signature in black ink, appearing to read "Philip L. Malet", is written over a horizontal line.

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December 8, 1997

Attachment



INTERNATIONAL TELECOMMUNICATION UNION

**RADIOCOMMUNICATION
STUDY GROUPS**

**Revision 1 to
Document 8/114-E
13 June 1997
Original: English**

Source: Doc. 8D/210
Subject: Question ITU-R 210/8

Working Party 8D

DRAFT NEW RECOMMENDATION ITU-R M.[8D/XZ]*

**ESSENTIAL TECHNICAL REQUIREMENTS OF MOBILE EARTH STATIONS
FOR GLOBAL NON-GEOSTATIONARY MOBILE-SATELLITE SERVICE
SYSTEMS IN THE BANDS 1 - 3 GHz**

(Question ITU-R 210/8)

The ITU Radiocommunication Assembly,

considering

- a) that various technically and operationally different global non-geostationary (NGSO) satellite systems in the mobile-satellite service (MSS) are planned to commence operation in the near future;
- b) that these NGSO MSS systems are expected to provide personal communications on a global basis to either hand-held or transportable mobile earth stations (MES) terminals;
- c) that MES terminals are expected to operate with these global NGSO MSS systems in various countries and hence, the circulation of MES terminals is an important aspect of these systems;
- d) that the circulation of terminals among administrations is usually subject to a number of regulations including satisfactory type approval to an agreed technical standard;
- e) that there is a need for identifying the essential technical requirements for the type approval of MES terminals of global NGSO MSS systems;

* This Recommendation should be brought to the attention of the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO), particularly with respect to the operational techniques referred to in *recommends 3*.

- f) that there is a need to protect safety services;
- g) that the essential technical requirements should achieve an acceptable balance between equipment design and production cost and the need for effective use of the radio frequency spectrum and should be impartial with respect to all global NGSO MSS technologies, subject to the protection of other radio systems;
- h) that the specification of values for essential technical requirements for TDMA NGSO MSS systems would not prevent the specification of the same or higher values for CDMA NGSO MSS systems,

considering also

- a) that the World Telecommunication Policy Forum (WTPF-96) which addressed Global Mobile Personal Communications by Satellite (GMPCS) policy and regulatory issues, adopted Opinion No. 3, calling upon the three ITU Sectors, each within its competence, to initiate new studies or pursue current ones, and to reach conclusions as soon as practicable to facilitate the introduction of GMPCS on a global and regional basis;
- b) that the World Telecommunication Policy Forum (WTPF-96) which addressed Global Mobile Personal Communications by Satellite (GMPCS) policy and regulatory issues, also adopted Opinion No. 4, establishment of a Memorandum of Understanding (MoU) to facilitate the circulation of GMPCS user terminals (GMPCS-MoU) which, *inter alia*, requested the Secretary-General of the ITU to take the necessary steps to prepare a GMPCS-MoU related to the circulation of GMPCS user terminals to facilitate the full implementation of GMPCS;
- c) that the development of relevant ITU Recommendations could facilitate the preparation and adoption of the GMPCS-MoU;
- d) that the identification by the ITU-R of essential technical requirements for MES terminals operating with global NGSO MSS systems would provide a common technical basis for facilitating type approval of MES terminals by various national authorities and the development of mutual recognition arrangements for type approvals of MES terminals and mutual recognition arrangements for circulation of MES terminals among administrations;
- e) that the identification by the ITU-R of essential technical requirements for MES terminals operating with global NGSO MSS systems in the 1 to 3 GHz range would ensure that interference will not be caused to other radio services by NGSO MSS MES terminals;
- f) that other relevant technical characteristics are prescribed by the Radio Regulations that pertain to the effective use of the radio frequency spectrum by mobile earth stations;
- g) that Recommendation ITU-R [Document 1/24] contains a list of radio equipment parameters that are relevant to achieve spectrum efficiency and compatibility;
- h) that, for a particular GMPCS system, some MES equipment parameters such as EIRP and necessary bandwidth which are listed in Recommendation ITU-R [Document 1/24] but are not contained in this Recommendation, are contained in the information provided as part of the Appendix S4 of the Radio Regulations,

considering further

- a) that it would be necessary for NGSO MSS systems to have the capability to determine the location of the MES terminals operating with NGSO MSS systems in order to fulfil the relevant requirements of Resolution 25 (WRC-95) and WTPF-96 Opinion No.2;

- b) that essential technical requirements should be measurable and testable,

recommends

1 that the essential technical requirements of MES terminals for global NGSO MSS systems in the bands 1 - 3 GHz in Annexes 1 and 2 should be used by administrations as a common technical basis for:

- a) establishing type approval requirements for MES terminals;
- b) facilitating the licensing of MES terminal operations;
- c) facilitating the development of mutual recognition arrangements of type approval of MES terminals;
- d) facilitating the development of mutual recognition arrangements to facilitate the circulation and use of MES terminals;

2 that the NGSO MSS systems should be capable of determining the location of its operating MES terminals;

3 that the further studies mentioned in Note 4 to Table 2A1 be initiated expeditiously, and include study of the values and operational techniques that may enable the values to be met, and that final e.i.r.p. values for the bands between 1 580.42 MHz and 1 605 MHz and for the band 1 605 - 1 610 MHz, be identified in time to modify this Recommendation appropriately during the 1997-1999 ITU-R study period.

NOTE 1 – The operational techniques referred to in this Recommendation should be brought to the attention of civil aviation authorities.

NOTE 2 – Administrations which, for national spectrum management purposes, require additional information on equipment parameters which are listed in Recommendation ITU-R [Document 1/24] but are not contained in this Recommendation, can obtain this information from the relevant RR Appendix S4 parameters.

ANNEX 1

**ESSENTIAL TECHNICAL REQUIREMENTS OF MES FOR GLOBAL NGSO MSS
SYSTEMS IN THE BANDS 1 - 3 GHz USING TDMA**

This annex contains essential technical requirements for MES terminals of global NGSO MSS systems using TDMA and operating in the bands 1 - 3 GHz. The tables on the following pages of this annex summarize the maximum unwanted emission requirements for such terminals. In addition to these unwanted emission requirements there is an additional requirement for automatic shut-off features of MES terminals which is:

Automatic Shut-off Features: The MES terminals should include a means of identifying whether there is a malfunctioning processor or other fault in its operation and be capable of automatically shutting down transmissions in the case of an identified malfunction no later than one second after a malfunction has been identified.

Throughout this Recommendation, various terms which are defined in the Radio Regulations are used. In addition to these terms there is an additional essential term which is defined as follows:

Nominated bandwidth (B_n): The B_n of the MES radio frequency transmission is wide enough to encompass all spectral elements of the transmission which have a level greater than the specified levels of unwanted emissions. The B_n is defined relative to the MES actual carrier frequency f_c .

B_n is the width of the frequency interval ($f_c - a, f_c + b$), where a and b , which is specified by the terminal manufacturer, may vary with f_c .

The frequency interval ($f_c - a, f_c + b$) does not encompass more than either:

- i) when $a = b$, 4 nominal carrier frequencies,
- ii) when $a \neq b$, 1 nominal carrier frequency.

The frequency interval ($f_c - a, f_c + b$) is within the assigned band of the MES terminals.

TABLE 1A1
Maximum unwanted emissions outside the band 1 610 to 1 626.5 MHz
and the band 1 626.5 to 1 628.5 MHz for an MES using TDMA access techniques

Frequency (MHz)	Carrier-on	
	e.i.r.p. (dBW) (NOTE 1)	Measurement Bandwidth
0.1 - 30	-66	10 kHz
30 - 1 000	-66	100 kHz
1 000 - 1 559	-60	1 MHz
1 559 - 1 573.42	-70	1 MHz (NOTE 2)
1 573.42 - 1 580.42	-70 (NOTE 3)	1 MHz (NOTE 2)
1 580.42 - 1 590	-70	1 MHz (NOTE 2)
1 590 - 1 605	-70	1 MHz (NOTE 2)
1 605 - 1 610	(NOTE 4)	1 MHz (NOTE 2)
1 610 - 1 626.5	Not applicable (NOTE 5)	Not applicable
1 626.5 - 1 628.5	Not applicable	Not applicable
1 628.5 - 1 631.5	-60	30 kHz
1 631.5 - 1 636.5	-60	100 kHz
1 636.5 - 1 646.5	-60	300 kHz
1 646.5 - 1 666.5	-60	1 MHz
1 666.5 - 2 200	-60	3 MHz
2 200 - 12 750	-60	3 MHz

NOTE 1 – Average responding instruments should be used to measure the eirp values. Except when NOTE 3 applies:

- i) the measurement time should be such that the difference of the measured e.i.r.p. levels, averaged over subsequent measurement samples, is less than 1 dB at any particular measurement frequency, or
- ii) a measurement time of 100 ms may be used if the measured e.i.r.p. values comply with the applicable limits.

For non-continuous signals the measurement should be performed over the active part of the burst.

NOTE 2 – Measurement bandwidths less than 1 MHz (e.g. 30 kHz, 100 kHz or 300 kHz) are allowable provided the power in the narrower bandwidth is integrated over 1 MHz.

NOTE 3 – Averaged over 20 ms.

NOTE 4: -70 dBW/MHz at 1 605 MHz, linearly interpolated in dB/MHz, to -10 dBW/MHz at 1 610 MHz. Appropriate protection of the Global Navigation Satellite System (GNSS) needs to be considered, recognizing the current operation and phased transition of the GLONASS system into the new frequency plan. The Russian Federation states that the level of -70 dBW/MHz shall be used to provide protection of GLONASS receiver operations and that a level of -37 dBW/MHz at 1 610 MHz, linearly interpolated to -70 dBW/MHz at 1 607.5 MHz, is sufficient to protect GLONASS wideband operations in the final GLONASS frequency plan.

NOTE 5 – MESs shall operate in the frequency band 1 610 - 1 626.5 MHz in accordance with RR S5.364. Subject to modification of the GLONASS frequency plan and operating GLONASS receivers, MSS operators, through national administrations, should apply the procedures of Resolution 46 (Rev. WRC-95) to reach agreement, on a bilateral basis, to acceptable conditions for the joint operation of the GLONASS and MSS systems, including testing to ensure electromagnetic compatibility between the GLONASS receivers and MESs.

TABLE 1A2

Maximum unwanted emissions within the allocated band 1 610.0 to 1 626.5 MHz and the band 1 626.5 to 1 628.5 MHz of an MES operating such that the nominated bandwidth is entirely or partially contained in the frequency band 1 618.25 to 1 626.5 MHz
(NOTES 1 and 2)

The maximum e.i.r.p. of the unwanted emissions inside the band 1 610.0 to 1 626.5 MHz and the band 1 626.5 to 1 628.5 MHz from MESs operating within the band 1 610.0 to 1 626.5 MHz should not exceed the limits in Table 1A2.

Frequency Offset (kHz) (NOTE 3)	Carrier-on	
	e.i.r.p. (dBW) (NOTE 4)	Measurement bandwidth (kHz) (NOTE 5)
0 to 160	- 35	30
160 to 225	- 35 to - 38.5	30
225 to 650	- 38.5 to - 45	30
650 to 1 365	- 45	30
1 365 to 1 800	- 53 to - 56	30
1 800 to 16 500	- 56	30

NOTE 1 – Average responding instruments should be used to measure the e.i.r.p. values. The measurement time should be such that the difference of the measured e.i.r.p. levels, averaged over subsequent measurement samples, is less than 1 dB at any particular measurement frequency. Alternatively, a measurement time of 100 ms may be used if the measured e.i.r.p. values comply with the applicable limits. For non-continuous signals, the measurement should be performed over the active part of the burst.

NOTE 2 – The MES should include means of inhibiting transmissions when necessary to protect the radioastronomy service in the 1 610.6 - 1 613.8 MHz band from emissions produced by the MES.

NOTE 3 – Frequency offset is determined from:

- i) the nearest edge of the nominated bandwidth of the nominal carrier closest to the MSS system operating in another assigned band within the band 1 610 to 1 626.5 MHz. The frequency offset is measured in the direction of the adjacent MSS system.
- ii) the upper edge of the nominated bandwidth of the carrier under test for emissions within the band 1 626.5 to 1 628.5 MHz.

NOTE 4 – Linearly interpolated in dBW versus frequency offset.

NOTE 5 – The measurement bandwidth used may be 3 kHz if the unwanted e.i.r.p. limits are reduced correspondingly.

TABLE 1A3
Maximum e.i.r.p. of the unwanted emissions of an MES in the carrier-off state

Frequency (MHz)	e.i.r.p. (dBW)	Measurement bandwidth
0.1 - 30	- 87	10 kHz
30 - 1 000	- 87	100 kHz
1 000 - 12 750	- 77	100 kHz
NOTE - Peak hold measurement techniques should be used. These values must be at or below the values for the carrier-on state.		

TABLE 1B1
Maximum unwanted emissions outside the 1 980 - 2 025 MHz allocations ,
from an MES (NOTE 1)

Frequency (MHz)	Carrier-on	
	e.i.r.p. (dBW) (NOTE 2)	Measurement Bandwidth
0.1 - 30	- 66	10 kHz
30 - 1 000	- 66	100 kHz
1 000 - 1 559	- 60	3 MHz
1 559 - 1 626.5	-70 (NOTE 3)	1 MHz
1 626.5 - 1 950	- 60	3 MHz
1 950 - 1 960	- 60	1 MHz
1 960 -1 970	- 60	300 kHz
1 970 - 1 975	- 60	100 kHz
1 975 - 1 978	- 60	30 kHz
1 978 - 1 980	The levels in Table 1B2, as appropriate, for the frequency offset 0 - 2 MHz. should apply from 1 978 - 1 980 MHz.	
1 980 to y (NOTE 4)	Not applicable	Not applicable
y to y+2	The levels in Table 1B2, as appropriate, for the frequency offset 0 - 2 MHz should apply from y to y+2 MHz.	
y+2 to y+5	- 60	30 kHz
y+5 to y+10	- 60	100 kHz
y+10 to y+20	- 60	300 kHz
y+20 to y+30	- 60	1 MHz
y+30 to 12 750	- 60	3 MHz

NOTE 1 – The MSS (Earth-to-space) is allocated frequencies on a co-primary basis in the band 1 980 - 2 010 MHz in all Regions and in the band 2 010 - 2 025 MHz in Region 2 subject to the dates of entry into force mentioned in RR S5.389A, RR S5.389C and RR S5.389D.

NOTE 2 – Average responding instruments should be used to measure the eirp values. Except when NOTE 3 applies:

- i) the measurement time should be such that the difference of the measured e.i.r.p. levels, averaged over subsequent measurement samples, is less than 1 dB at any particular measurement frequency, or
- ii) a measurement time of 100 ms may be used if the measured e.i.r.p. values comply with the applicable limits.

For non-continuous signals the measurement should be performed over the active part of the burst.

NOTE 3 – Averaged over 20 ms.

NOTE 4 – The value of y (MHz) corresponds to the upper band edge of the allocation.

TABLE 1B2

Maximum unwanted emissions from an MES using TDMA access technique within the 1 980 - 2 025 MHz allocations (NOTES 1 and 2)

Frequency offset (kHz) (NOTE 3)	Carrier-on	
	e.i.r.p. (dBW)	Measurement bandwidth (kHz)
0 to 166	0 - (offset \times 55/166)	3 kHz
166 to 575	- 55	3 kHz
575 to 1 175	- 60	3 kHz
1 175 to 1 525	-50 - ((offset - 1 175) \times 5/350)	30 kHz
1 525 to 45 000	- 55	30 kHz

NOTE 1 – The MSS (Earth-to-space) is allocated frequencies on a co-primary basis in the band 1 980 - 2 010 MHz in all Regions and in the band 2 010 - 2 025 MHz in Region 2 subject to the dates of entry into force mentioned in RR S5.389A, RR S5.389C and RR S5.389D.

NOTE 2 – Average responding instruments should be used to measure the e.i.r.p. values. The measurement time should be such that the difference of the measured e.i.r.p. levels, averaged over subsequent measurement samples, is less than 1 dB at any particular measurement frequency. Alternatively, a measurement time of 100 ms may be used if the measured e.i.r.p. values comply with the applicable limits. For non-continuous signals, the measurement should be performed over the active part of the burst.

NOTE 3 – Frequency offset is determined from edge of nominated bandwidth.

TABLE 1B3

Maximum e.i.r.p. of the unwanted emissions of an MES in the carrier-off state

Frequency (MHz)	e.i.r.p. (dBW)	Measurement bandwidth
0.1 - 30	- 87	10 kHz
30 - 1 000	- 87	100 kHz
1 000 - 12 750	- 77	100 kHz
NOTE – Peak hold measurement techniques should be used. These values must be at or below the values for the carrier-on state.		

ANNEX 2

**ESSENTIAL TECHNICAL REQUIREMENTS OF MES FOR GLOBAL NGSO MSS
SYSTEMS IN THE BANDS 1 - 3 GHz USING CDMA**

This annex contains essential technical requirements for MES terminals of global NGSO MSS systems using CDMA and operating in the bands 1 - 3 GHz. The tables on the following pages of this annex summarize the maximum unwanted emission requirements for such terminals. In addition to these unwanted emission requirements there is an additional requirement for automatic shut-off features of MES terminals which is:

Automatic Shut-off Features: The MES should include a means of identifying whether there is a malfunctioning processor or other fault in its operation and be capable of automatically shutting down transmissions in the case of an identified malfunction no later than one second after a malfunction has been identified.

Throughout this Recommendation, various terms, which are defined in the Radio Regulations are used. In addition to these terms there is an additional essential term which is defined in this Recommendation as follows:

Nominated bandwidth (B_n) (NOTE 1): The B_n of the MES radio frequency transmission is wide enough to encompass all spectral elements of the transmission which have a level greater than the specified levels of unwanted emissions. The B_n is defined relative to the MES actual carrier frequency f_c .

B_n is the width of the frequency interval ($f_c - a$, $f_c + b$), where a and b , which is specified by the terminal manufacturer, may vary with f_c .

The frequency interval ($f_c - a$, $f_c + b$) does not encompass more than either:

- i) when $a = b$, 4 nominal carrier frequencies for narrow-band systems;
- ii) when $a \neq b$, 1 nominal carrier frequency for narrow-band systems; or
- iii) 1 nominal carrier frequency for wide-band systems.

The frequency interval ($f_c - a$, $f_c + b$) is within the assigned band of the MES.

NOTE 1 – A narrowband system in this context is a system in which the nominal carrier frequency spacing for MES transmissions in the Earth-to-space direction is less than 300 kHz. If this frequency spacing is greater than 300 kHz, the system is wideband.

TABLE 2A1

**Maximum unwanted emissions outside the band 1 610 to 1 626.5 MHz
and the band 1 626.5 to 1 628.5 MHz for an MES using CDMA access techniques**

Frequency (MHz)	Carrier-on	
	e.i.r.p. (dBW) (NOTE 1)	Measurement Bandwidth
0.1 - 30	- 66	10 kHz
30 - 1 000	- 66	100 kHz
1 000 - 1 559	-60	1 MHz
1 559 - 1 573.42	-70	1 MHz (NOTE 2)
1 573.42 - 1 580.42	-70 (NOTE 3)	1 MHz (NOTE 2)
1 580.42 - 1 590	(NOTE 4)	1 MHz (NOTE 2)
1 590 - 1 605	(NOTE 4)	1 MHz (NOTE 2)
1 605 - 1 610	(NOTE 4) (NOTE 5)	1 MHz (NOTE 2)
1 610 - 1 626.5 (NOTE 6)	Not applicable	Not applicable
1 626.5 - 1 628.5	Not applicable	Not applicable
1 628.5 - 1 631.5	-60	30 kHz
1 631.5 - 1 636.5	-60	100 kHz
1 636.5 - 1 646.5	-60	300 kHz
1 646.5 - 1 666.5	-60	1 MHz
1 666.5 - 2 200	-60	3 MHz
2 200 - 12 750	-60	3 MHz

NOTE 1 – Average responding instruments should be used to measure the eirp values. Except when NOTE 3 applies:

- i) the measurement time should be such that the difference of the measured e.i.r.p. levels, averaged over subsequent measurement samples, is less than 1 dB at any particular measurement frequency, or
- ii) a measurement time of 100 ms may be used if the measured e.i.r.p. values comply with the applicable limits.

For non-continuous signals the measurement should be performed over the active part of the burst.

NOTE 2 – Measurement bandwidths less than 1 MHz (e.g. 30 kHz, 100 kHz or 300 kHz) are allowable provided the power in the narrower bandwidth is integrated over 1 MHz.

NOTE 3 – Averaged over 20 ms.

NOTE 4 – The e.i.r.p. values for the bands 1 580.42 - 1 590 MHz, 1 590 - 1 605 MHz, and for the lower band edge in the 1 605 - 1 610 MHz band require further study. See *recommends 3*. An MES terminal that meets a value of -70 dBW/MHz, prior to the completion of further study, will be considered to have met the final values in the bands stated above and at 1 605 MHz, since those final values will be no lower than -70 dBW/MHz. The assignment of frequencies to an MES terminal by an MSS system should enable an e.i.r.p. value of -70 dBW/MHz for the protection of GNSS to be fulfilled. The e.i.r.p. value of -70 dBW is subject to further study in ITU-R.

NOTE 5 – Taking into account Note 4, the value at 1 605 MHz, linearly interpolated in dB/MHz, to -10 dBW/MHz at 1 610 MHz. Appropriate protection of GNSS needs to be considered, recognizing the current operation and phased transition of the GLONASS system into the new frequency plan. The Russian Federation states that the level of -70 dBW/MHz shall be used to provide protection of GLONASS receiver operations and that a level of -37 dBW/MHz at 1 610 MHz, linearly interpolated to -70 dBW/MHz at 1 607.5 MHz, is sufficient to protect GLONASS wideband operations in the final GLONASS frequency plan.

NOTE 6 – Mobile earth stations shall operate in the frequency bands 1 610 - 1 626.5 MHz in accordance with RR S5.364. Subject to modification of the GLONASS frequency plan and operating GLONASS receivers, MSS operators, through national administrations, should apply the procedures of Resolution 46 (Rev. WRC-95) to reach agreement, on a bilateral basis, to acceptable conditions for the joint operation of the GLONASS and MSS systems, including testing to ensure electromagnetic compatibility between the GLONASS receivers and MES.

TABLE 2A2

Maximum unwanted emissions within the allocated band 1 610.0 to 1 626.5 MHz and the band 1 626.5 to 1 628.5 MHz of an MES operating such that the nominated bandwidth is entirely or partially contained in the frequency band 1 618.25 to 1 626.5 MHz
(NOTES 1 and 2)

The maximum e.i.r.p. of the unwanted emissions inside the band 1 610.0 to 1 626.5 MHz and the band 1 626.5 to 1 628.5 MHz from MESs operating within the band 1 610.0 to 1 626.5 MHz should not exceed the limits in Tables 2A2 or 2A3.

Frequency Offset (kHz) (NOTE 3)	Carrier-on	
	e.i.r.p. (dBW) (NOTE 4)	Measurement bandwidth (kHz) (NOTE 5)
0 to 160	- 35	30
160 to 225	- 35 to - 38.5	30
225 to 650	- 38.5 to - 45	30
650 to 1 365	- 45	30
1 365 to 1 800	- 53 to - 56	30
1 800 to 16 500	- 56	30

NOTE 1 – Average responding instruments should be used to measure the e.i.r.p. values. The measurement time should be such that the difference of the measured e.i.r.p. levels, averaged over subsequent measurement samples, is less than 1 dB at any particular measurement frequency. Alternatively, a measurement time of 100 ms may be used if the measured e.i.r.p. values comply with the applicable limits. For non-continuous signals, the measurement should be performed over the active part of the burst.

NOTE 2 – The MES should include means of inhibiting transmissions when necessary to protect the radioastronomy service in the 1 610.6 - 1 613.8 MHz band from emissions produced by the MES.

NOTE 3 – Frequency offset is determined from:

- i) the nearest edge of the nominated bandwidth of the nominal carrier closest to the MSS system operating in another assigned band within the band 1 610 to 1 626.5 MHz. The frequency offset is measured in the direction of the adjacent MSS system.
- ii) the upper edge of the nominated bandwidth of the carrier under test for emissions within the band 1 626.5 to 1 628.5 MHz.

NOTE 4 – Linearly interpolated in dBW versus frequency offset.

NOTE 5 – The measurement bandwidth used may be 3 kHz if the unwanted e.i.r.p. limits are reduced correspondingly.

TABLE 2A3

Maximum unwanted emissions within the allocated band 1 610.0 to 1 626.5 MHz and the band 1 626.5 to 1 628.5 MHz of an MES operating such that the nominated bandwidth is entirely contained in the frequency band 1 610.0 to 1 618.25 MHz (NOTES 1 and 2)

Frequency Offset (kHz) (NOTE 3)	Carrier-on	
	e.i.r.p. (dBW) (NOTE 4)	Measurement bandwidth (kHz) (NOTE 5)
0 to 160	- 32	30
160 to 2 300	- 32 to - 56	30
2 300 to 16 500	- 56	30

NOTE 1 – Average responding instruments should be used to measure the e.i.r.p. values. The measurement time should be such that the difference of the measured e.i.r.p. levels, averaged over subsequent measurement samples, is less than 1 dB at any particular measurement frequency. Alternatively, a measurement time of 100 ms may be used if the measured e.i.r.p. values comply with the applicable limits. For non-continuous signals, the measurement should be performed over the active part of the burst.

NOTE 2 – The MES should include means of inhibiting transmissions when necessary to protect the radioastronomy service in the 1 610.6 - 1 613.8 MHz band from emissions produced by the MES.

NOTE 3 – Frequency offset is determined from:

- i) the nearest edge of the nominated bandwidth of the nominal carrier closest to the MSS system operating in another assigned band within the band 1 610 to 1 626.5 MHz. The frequency offset is measured in the direction of the adjacent MSS system.
- ii) the upper edge of the nominated bandwidth of the carrier under test for emissions within the band 1 626.5 to 1 628.5 MHz.

NOTE 4 – Linearly interpolated in dBW versus frequency offset.

NOTE 5 – The measurement bandwidth used may be 3 kHz if the unwanted e.i.r.p. limits are reduced correspondingly.

TABLE 2A4

Maximum unwanted emissions of an MES using CDMA access techniques within the assigned band of CDMA carriers (NOTE 1)

Frequency offset (kHz) (NOTE 2)	Carrier-on	
	e.i.r.p. (dBW) (NOTE 3)	Measurement bandwidth (kHz) (NOTE 4)
0 to 70	- 6 to - 20	30
70 to 600	- 20 to - 28	30
600 to 2 000	- 28 to - 45	30
2 000 to 5 000	- 45 to - 69	30
5 000 to 16 500	- 69	30

NOTE 1 – Average responding instruments should be used to measure the e.i.r.p. values. The measurement time should be such that the difference of the measured e.i.r.p. levels, averaged over subsequent measurement samples, is less than 1 dB at any particular measurement frequency. Alternatively, a measurement time of 100 ms may be used if the measured e.i.r.p. values comply with the applicable limits. For non-continuous signals, the measurement should be performed over the active part of the burst.

NOTE 2 – Frequency offset is determined from edge of nominated bandwidth.

NOTE 3 – Linearly interpolated in dBW versus frequency offset.

NOTE 4 – The measurement bandwidth used may be 3 kHz if the unwanted e.i.r.p. limits are reduced correspondingly.

TABLE 2A5

Maximum e.i.r.p. of the unwanted emissions of an MES in the carrier-off state

Frequency (MHz)	e.i.r.p. (dBW)	Measurement bandwidth
0.1 - 30	- 87	10 kHz
30 - 1 000	- 87	100 kHz
1 000 - 12 750	- 77	100 kHz

NOTE – Peak hold measurement techniques should be used. These values must be at or below the values for the carrier-on state.